

CLAIMS

1. A progressive lossless video coding method that performs video coding which allows decoding that matches an original signal comprising:

a step that inputs a residual signal obtained by subtracting a prediction signal from an original signal for each block of an image signal, the prediction signal conforming to a predetermined lossy video coding scheme and being obtained by space prediction in intra-frame coding or by time prediction in inter-frame coding;

a step that determines transform coefficients obtained by applying orthogonal transformation on the residual signal and quantization coefficients obtained by quantizing the transform coefficients based on the lossy video coding scheme;

a step that identifies existential space of transformed coefficients established from the quantization coefficients, and quantization parameters and quantization methods used during quantization;

a validity judging step that judges whether grid points in the existential space of the transform coefficients are valid as a result of orthogonal transformation of the residual signal;

an enumerating step that searches, in a predetermined grid point order, grid points for which the judgment is valid from the grid points in the existential space of the transform coefficients, and enumerates the grid points thus searched;

a step that assigns serial numbers in the order of enumeration to enumerated grid points;

a step that acquires serial numbers of grid points matching the transform coefficients of the residual signal from the enumerated grid points, and

a step that codes and outputs the serial numbers of the grid points matching the transform coefficients of the residual signal.

2. The progressive lossless video coding method as set forth in claim 1, wherein, in the enumerating step that enumerates the grid points for which the judgment is valid from the grid points in the existential space of the transform coefficients, processing of judgment on whether the grid points are valid as the result of the orthogonal transformation of the residual signal is omitted for grid points at which transform coefficients cannot take in the space by using an integer value relationship between the transform coefficients.

3. The progressive lossless video coding method as set forth in claim 1 or 2, further comprising a step that outputs information excluding values for which some specific transform coefficients cannot take by using an integer value relationship between the specific transform coefficients and coefficients which have been already output, instead of outputting the specific transform coefficients,

wherein, in the enumerating step that enumerates grid points for which the judgment is valid from the grid points in the existential space of the transform coefficients, the grid points are enumerated in existential space having a reduced dimension using the transform coefficients output beforehand.

4. The progressive lossless video coding method as set forth in any of claim 1 to claim 3, wherein the validity judging step judges validity using only bit operations, integer addition, and integer subtraction.

5. The progressive lossless video coding method as set forth in any of claim 1 to claim 4, wherein, by using the knowledge that an intersection between an existential range of the residual signal and an existential range of the transform coefficients becomes a convex polyhedron, the validity judgment is suspended halfway when the grid points to be judged exist outside the convex polyhedron.

6. The progressive lossless video coding method as set forth in any of claim 1 to claim 3, further comprising a step that estimates a coding amount without executing the enumerating step that enumerates the grid points for which the judgment is valid from the grid points in the existential space of the transform coefficients.

7. A decoding method for decoding coded streams coded by the progressive lossless video coding method as set forth in any of claim 1 to claim 6, comprising:

a step that executes a decoding scheme corresponding to the predetermined lossy video coding scheme;

a step that identifies existential space of transform coefficients established from quantization parameters, quantization coefficients, quantization methods on a coding side, and, if any, already decoded coefficients;

a step that decodes coefficients that need to be decoded;

a validity judging step that judges whether a grid point in the existential space of the transform coefficients is valid as a result of orthogonal transformation of the residual signal;

an enumerating step that searches grid points from the grid points in the existential space of the transform coefficients for which the judgment is valid in the same order as the order of search of the grid points during coding;

a step that decodes serial numbers; and

a step that outputs grid points having orders that are equal to the decoded serial numbers from enumerated grid points.

8. A lossless video coding apparatus that performs video coding which allows decoding that matches an original signal, comprising:

a means that inputs a residual signal obtained by subtracting a prediction signal from an original signal for each block of an image signal, the prediction signal conforming to a predetermined lossy video coding scheme and being obtained by space prediction in intra-frame coding or by time prediction in inter-frame coding;

a means that determines transform coefficients obtained by applying orthogonal transformation on the residual signal and quantization coefficients obtained by quantizing the transform coefficients based on the lossy video coding scheme;

an existential space deciding means that identifies existential space of transformed coefficients established from the quantization coefficients, and quantization parameters and quantization methods used during quantization;

a validity judging means that judges whether grid points in the existential space of the transform coefficients are valid as a result of the orthogonal transformation of the residual signal;

an enumerating means that searches, in a predetermined grid point order, grid points for which the judgment is valid from the grid points in the existential space of the transform coefficients, and enumerates the grid points thus searched;

a means that assigns serial numbers in the order of enumeration to enumerated grid points;

a means that acquires serial numbers of grid points matching the transform coefficients of the residual signal from enumerated grid points, and

a means that codes and outputs the serial numbers of the grid points matching the transform coefficients of the residual signal.

9. A lossless video decoding apparatus that decodes coded streams coded by the progressive lossless video coding apparatus as set forth in claim 8, comprising:

a means that executes a decoding scheme corresponding to the predetermined lossy video coding scheme;

an existential space determining means that identifies existential space of transform coefficients established from quantization parameters, quantization coefficients, quantization methods on a coding side, and, if any, already decoded coefficients;

a coefficient decoding means that decodes coefficients that need to be decoded;

a validity judging means that judges whether a grid point in the existential space of the transform coefficients is valid as a result of orthogonal transformation of the residual signal;

an enumerating means that searches grid points from the grid points in the existential space of the transform coefficients for which the judgment is valid in the same order as the order of search of grid points during coding;

a serial number decoding means that decodes serial numbers; and

an output means that outputs grid points having orders that are equal to the decoded serial numbers from enumerated grid points.

10. A progressive lossless video coding program for executing the progressive lossless video coding method as set forth in any of claim 1 to claim 6 on a computer.

11. A progressive lossless video decoding program for executing the progressive lossless video decoding method as set forth in claim 7 on a computer.

12. A recording medium for progressive lossless video coding program wherein a program for executing on a computer the progressive lossless video coding method as set forth in any of claim 1 to claim 6 is recorded on a recording medium that can be read by the computer.

13. A recording medium for progressive lossless video decoding program wherein a program for executing on a computer the progressive lossless video decoding method as set forth in claim 7 is recorded on a recording medium that can read by the computer.